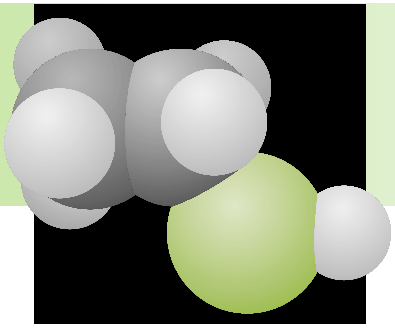
CHEMICALS

Project Fact Sheet



PHASE TRANSFER CATALYSIS

BENEFITS

- Energy savings of 8 x 10^{11} Btu per year
- Reduces CO_2 emissions by 78,000 tons per year
- Reduces waste treatment costs
- Reduces hazardous waste
- Eliminates solvent in extraction and recovery operations

APPLICATIONS

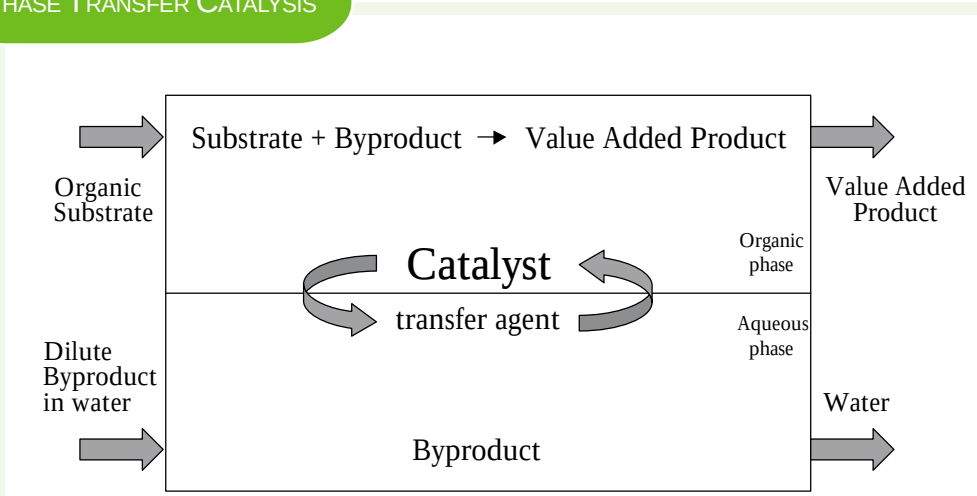
Phase transfer catalysis (PTC) technology can be applied to a wide variety of byproduct streams in the chemical process industry. The production of adhesive, polymers, explosives, petroleum, flavors, and fragrances can utilize PTC to convert organic and inorganic byproducts to valuable specialty chemicals.

A NEW SOURCE OF SPECIALTY CHEMICALS IS ACHIEVED THROUGH CATALYSIS OF BYPRODUCT STREAMS

Phase transfer catalysis (PTC) is a method for converting dilute byproduct streams into value added products rather than greenhouse gases or other wastes. The catalyst in PTC acts as a shuttling agent, extracting the byproduct from the aqueous (or solid) phase and transfering it into the organic phase. As shown in the diagram below, the catalyst removes the dilute byproduct from the aqeuous phase, and delivers it to the organic phase. The byproduct now in the organic phase can freely combine with an organic reactant to form a value added product. The catalyst significantly enhances the reactivity of the byproduct so that it can be converted into a value added product. The catalyst is a 'true' catalyst in the classical sense and is not consumed in the reaction. Once the organic phase reaction is complete, the phase transfer catalyst returns to the water phase, picks up additional byproducts, and repeats the cycle.

This project will focus on the development of process kinetics for a commercial scale PTC continuous process system that will convert specific byproducts present in dilute aqueous streams into saleable specialty chemicals. The salable products depend on the nature and identity of the byproduct components and the choice of substrate.

PHASE TRANSFER CATALYSIS



Phase transfer catalysis utilizes the catalyst as a transfer agent to remove dilute byproducts from an aqueous phase to an organic phase where the byproduct is consumed in a reaction with an organic substrate to produce a value added product and a water phase.

Project Description

Goal: To provide an economic, small-scale, continuous demonstration of phase transfer catalysis technology that converts previously wasted byproducts present in dilute aqueous streams into salable specialty chemicals.

Progress and Milestones

Progress to date:

- Demonstrated proof-of-concept on a high volume hazardous waste stream which contain phenol and phenol derivatives. The phenol and phenol derivatives were successfully catalytically extracted from the dilute aqueous solution and reacted with various organics to form a variety of useful ethers and esters
- Converted acetate from a dilute aqueous stream into an item of commerce

Future research will focus on the following:

- Demonstrate scalable, continuous reactor kinetics and economics for PTC systems applied to byproduct conversion
- Widen the scope of PTC systems for byproduct conversion by evaluating a minimum of five new chemistry systems
- Demonstrate continuous catalyst/solvent separation and solvent recycle
- Demonstrate a continuous solvent-free system by reacting organic substrates, thus eliminating the need for solvents
- Produce accurate economic design data for PTC systems and provide an integrated solution to specific customer applications

Commercialization

PTC Value Recovery will market the technology under the name PTC Value Recovery® System. The following byproducts are potentially amenable to phase transfer catalyst technology:

Anions and Easily Ionizable Compounds- Examples

Phenols: phenol, bis-phenol A, cresol and their sodium salts

Mercaptans/Thiols: methyl mercaptan, butyl mercaptan, dodecyl mercaptan, thiophenol and their sodium salts

Inorganic Nucleophiles: cyanide, iodide, thiocyanate, azide, sulfide

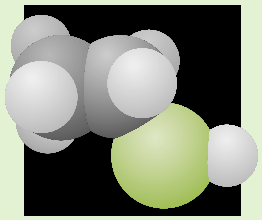
Ionizable Heterocycles: pyrrole, imidazole, carbazole

Carboxylic Acids: acetic acid, propionic acid, succinnic acid, phenylacetic acid, salicylic acid and their sodium salts

Neutral Compounds- Examples

Alkyl Halides: methyl chloride, ethyl chloride, butyl bromide, epichlorohydrin

Acyl Halides: benzoyl chloride, stearoyl chloride



Project Partners

PTC Value Recovery
Mt. Laurel, NJ

CINC Incorporated
Carson City, NV

Hercules Incorporated
Wilmington, DE

Iowa State University
Ames, IA

New Jersey Commission on Science and Technology
Trenton, NJ

PTC Organics, Incorporated
Mt. Laurel, NJ

Widner University
Chester, PA

For additional information, please contact:

Charles Russomanno
Office of Industrial Technologies
Phone: (202) 586-3818
Fax: (202) 586-3237
charles.russomanno@ee.doe.gov

Please send any comments, questions, or suggestions to webmaster.oit@ee.doe.gov

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Office of Industrial Technologies
Energy Efficiency
and Renewable Energy
U.S. Department of Energy
Washington, D.C. 20585

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